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Tailoring Functional Properties of Perovskite Oxides Using Anisotropic Epitaxy

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The ability to tailor functional properties of complex oxide thin films through epitaxial engineering has opened new avenues for oxide electronics and spintronics applications [1]. Lanthanum strontium manganite ($La_{1-x}Sr_xMnO_3$, LSMO) is a half-metallic perovskite oxide exhibiting a strong coupling among lattice strain, magnetism, and electronic transport [2]. Epitaxial strain engineering [3] of LSMO has been widely studied with both tensile and compressive strain reducing the magnetic transition temperature and controlling the orientation of the magnetic easy axis [4]. However, the influence of substrate miscut remains less understood.

This work investigates how anisotropic epitaxy, defined as the combined effects of epitaxial strain and substrate miscut, governs the structural, electronic, and magnetic properties of LSMO thin films. The films are grown by pulsed laser deposition on $SrTiO_3$, $LaAlO_3$, and LSAT substrates corresponding to tensile strain, compressive strain, and lattice-matched conditions, respectively. Substrate orientations include (001), (101), (102), and (103), enabling variation of miscut across the different strain states. High-resolution x-ray diffraction and reciprocal space mapping assess the crystallinity and strain relaxation, while atomic force microscopy characterises the surface morphology. Four-probe resistivity measurements as a function of temperature and magnetic field provide insights into the transport and magnetoresistive behaviour.

The findings aim to advance the understanding of how anisotropic epitaxy can be utilised to tailor perovskite-based materials for applications in spintronics and energy technologies. These results will provide a general framework for designing high-performance materials and devices based on epitaxial perovskite oxide thin films, highlighting the potential of anisotropic epitaxy in material science.

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